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2020-02

van den Born , R J G , Verbrugge , L & Ganzevoort , W 2020 , ' Assessing stakeholder perceptions of landscape and place in the context of a major river intervention : a call for their inclusion in adaptive management ' , Water policy , vol. 22 , no. 1 , pp. 19-36 . https://doi.org/10.2166/wp.2019.0

http://hdl.handle.net/10138/313868
https://doi.org/10.2166/wp.2019.073

Water Policy 22 (2020) 19–36

Assessing stakeholder perceptions of landscape and place in the context of a major river intervention: a call for their inclusion in adaptive management

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Abstract

Adaptive management strategies are required to manage multi-actor and multifunctional river landscapes. Such strategies need to be inclusive of perspectives of different stakeholders. We present a case study of a pilot engineering project in the Dutch river Waal, which drastically changed the appearance of the river landscape. We study perceptions of four stakeholder groups (residents, recreational anglers, recreational boaters and shipping professionals) regarding the impacts of this intervention on landscape values, including aesthetics, naturalness, biodiversity, flood safety and accessibility. Results show that stakeholders differ in which functions of the river landscape they find important and how they perceive the longitudinal dams to influence the landscape. They also differ in levels of place attachment and trust in the responsible authority. Shipping professionals stand out for their more negative evaluations of the dams compared to the other stakeholders, while especially residents demonstrate high levels of place identity and connection with nature. Residents also feel that the dams are improving flood risk safety in the area, and they positively evaluate knowledge and skills of Dutch water managers. These results provide water managers with much needed insights into landscape functions valued by different stakeholder groups and those perceived as most endangered by landscape interventions.

Keywords: Landscape values; Multifunctional river management; Place attachment; Stakeholder participation; Survey; Trust

doi: 10.2166/wp.2019.073

1. Introduction

Dealing with climate change and the consequent (near) floods and longer drought periods has rapidly gained prominence on the global and European policy agendas (Stein *et al*., 2016; Wiering *et al*., 2017). In the Netherlands, the focus of river management since the mid-19th century has been on technological aspects of flood prevention, aimed at controlling water (Wolsink, 2006; Warner *et al*., 2012). This technical approach to flood risk reduction was successful and received widespread public support until the 1970s. However, in the past decades, people living along the rivers have increasingly protested against the policy of dike enhancement, and new discourses in river management emerged focussing on nature protection and landscape quality (Van Heezik, 2007). The river's multifunctional potential, including its ecological, aesthetic and recreational value, was rediscovered (Disco, 2002; Wiering & Arts, 2006), and river management is increasingly combined with nature development and spatial planning. The main example of such an integrated river management approach in the Netherlands is the flood protection programme 'Room for the River' launched in 2006 and characterized by making more space for the river (Warner *et al*., 2012).

The focus of integrated river management lies on the multifunctionality of the landscape, which implies that the perceptions and concerns of various stakeholders, including citizens, need to be elicited, analysed and incorporated (Rijke *et al*., 2012; Pahl-Wostl, 2015). Several arguments have been made for the importance of public participation in water management, such as better informed and more creative decision-making, as well as increased legitimacy and public support (Mostert, 2003; Carr, 2015; Wohl *et al*., 2015). Ineffectively including the public may sometimes lead to resistance against river management projects (Carr, 2015; Pahl-Wostl, 2015). Despite international recognition of the importance of public involvement, for example through the European Water Framework Directive, recent studies show that the actual level of public participation is often low and that there is lack of clear criteria for the implementation and evaluation of participatory processes (Newig *et al*., 2014; Jager *et al*., 2016). In particular, the inclusion of citizens' perspectives and local knowledge in river management is often neglected (Junker *et al*., 2007; Michels, 2016) partly because challenges exist to incorporate these into institutionalized science-policy interfaces (Bergsma, 2016).

In the present study, we report on the perceptions of four stakeholder groups (residents, recreational anglers, recreational boaters and shipping professionals) on a major river landscape intervention and discuss how these can serve as a starting point for adaptive river landscape management. Adaptive management aims to incorporate the views and knowledge of all interested parties (Johnson, 1999b) and enables water managers to respond to new information in a setting of varied stakeholder objectives and preferences. As noted by Johnson (1999a: p .1): 'Sometimes, the most effective way to learn is to view management actions as experiments and design them to produce critical information about the resource being managed'. Our case study is a good example of such an experiment; it is embedded in the multi-disciplinary research project RiverCare (www.rivercare.nl), which monitors the intermediate and long-term effects of river interventions in order to improve their design and maintenance. We first introduce the case study and our research objectives. Next, we describe the concepts utilized in the design of this study. After discussing the methodological approach, we report the results of our survey, followed by a discussion of the results. The paper ends with our conclusions and recommendations for water managers.

Fig. 1. Situation of the longitudinal dams in the river landscape, from above (left; Beeldbank Rijkswaterstaat) and from below in the secondary channel (centre; Roland van Aalderen) and the view from the main channel to the shore (right; Beeldbank Rijkswaterstaat).

1.1. Case study

The case study concerns a 10-km trajectory of the river Waal in the Netherlands where longitudinal training dams were constructed in 2015. In this pilot engineering project, the traditional groynes were partly replaced by three dams situated parallel to the riverbank. This intervention resulted in the formation of a main and secondary channel and thus drastically changed the appearance of the Dutch river landscape (Figures 1 and 2). The goals of this intervention are to increase the discharge capacity of the river by reducing hydraulic resistance at high water levels, improve ecological conditions and navigability and reduce dredging costs (van Vuren *et al.*, 2015; Collas *et al.*, 2018). The Dutch Directorate for Public Works and Water (from here on referred to as Rijkswaterstaat) is responsible for the design, construction and maintenance of the longitudinal dams, which they initiated as a pilot project.

As this is the first construction of longitudinal dams in the Netherlands, with possibilities for applying this measure elsewhere, Rijkswaterstaat deemed it important to include public perceptions of and experiences with this landscape change in the 3-year monitoring programme and the evaluation of the dams. This monitoring programme was embedded within the WaalSamen group, consisting of representatives from the government, commercial and recreational sectors (i.e. recreational angling and inland shipping) and knowledge institutes. Their collective tasks are to (1) monitor the morphological, ecological and socio-economic consequences of this intervention in the river Waal, (2) support the integration of the resulting monitoring data (including public perception data) in adaptive management decisions and (3) formally evaluate the intervention after 4 years.

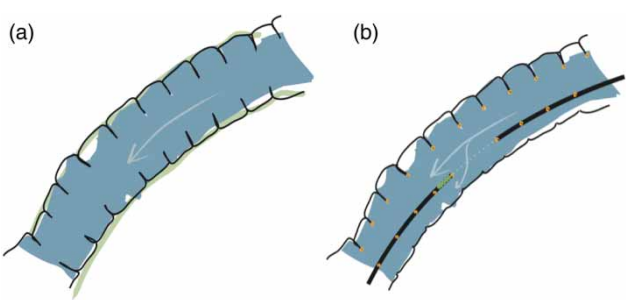

Fig. 2. Schematic overview of the river Waal before (a) and after (b) construction of the longitudinal dams (Rijkswaterstaat).

1.2. Research objective and research questions

The research objective of this study is to map perceptions of different stakeholder groups concerning the newly constructed longitudinal dams in the river Waal and propose how practitioners can take perception data into account to support the adaptive management of the river landscape. This objective is divided into two research questions:

1. What are the perceptions (place attachment, trust and views on the impact of the dams) of local residents, anglers, recreational boaters and shipping professionals of the longitudinal dams?
2. What are the lessons learned from our case study with regard to the inclusion of perception studies in adaptive management?

This paper reports the results of a perception survey study carried out among different stakeholder groups after the dams were constructed.

2. Theoretical framework

An evaluation of the societal success of river management requires insight into public perceptions and whether aims and benefits of public participation are achieved, e.g. if participants perceive the benefits of the project and if the project managers' decisions were legitimate (Carr, 2015). These insights can form the basis for adaptive management, in which water managers can respond to stakeholder perceptions by adapting the design of river interventions. The inclusion of these perceptions in river management requires an acknowledgement of 'the complex and dynamic nature–society relationship' and 'will be effective only if potential conflicts between stakeholders with differing worldviews and objectives can be identified and managed' (Smith *et al.*, 2014: p 256–257). Here, we outline three important concepts for studying stakeholder perceptions in river management that guided our survey design: the multifunctionality of river landscapes, people–place relationships and trust.

2.1. Multifunctionality of river landscapes

Rivers and floodplains provide many benefits to people related to water discharge (e.g. flood protection and water retention), water quality (e.g. drinking water facilities), transportation (e.g. inland navigation), recreation (on land and on water) and nature (e.g. biodiversity). Multifunctional floodplain management is an approach that aims to serve the needs of local residents and others directly or indirectly affected by river and floodplain management and policies (Secchi *et al.*, 2012). An investigation in six European countries concluded that the involvement of a broad range of stakeholders with diverse expertise and interests in planning and implementation is beneficial for gaining positive outcomes of multifunctional floodplain management, but the actual effects of such management interventions on the different functions the river provides remain largely undocumented (Schindler *et al.*, 2016).

Changing the physical surroundings creates trade-offs between the different functions a river provides. For example, canalization of rivers increases its suitability for navigation but decreases nature values. Kondolf & Pinto (2017: p. 182) introduced the concept of social connectivity to refer to

'communication and movement of people, goods, ideas, and culture along and across rivers, recognizing longitudinal, lateral and vertical connectivity'. Connectivity is influenced by factors such as whether people can see the river, whether people have access to the river or whether it can be used for transport.

In order to bring the benefits of river landscapes for people to the fore, there are different ways to assess them, and each method has its limitations and strengths. One example is the ecosystem services approach, which defines a service as 'the aspects of ecosystems utilized (actively or passively) to produce human well-being' (Fisher *et al.*, 2009). This approach commonly uses (monetary) valuation tools such as willingness to pay. While these can be useful instruments, particular landscape values such as aesthetics cannot easily be captured in monetary terms (Vermaat *et al.*, 2016). Other approaches have developed indicators for landscape values, such as the perceived attractiveness of river landscape features (e.g. the presence of water, vegetation and wildlife) and characteristics (e.g. landscape variety, unity, spaciousness or naturalness) (e.g. Nassauer, 2004; Buijs, 2009). Such approaches allow the incorporation of values that are less easily captured in monetary terms and are closer to how people experience the landscape (Brown & Raymond, 2007). These indicators allow for the assessment of changes in perceived landscape qualities, for example in the context of river restoration (Buijs, 2009).

In our case study, the newly constructed longitudinal dams form a new physical object in the river landscape. As such, they change the appearance of the landscape, as well as how the river can be used. In doing so, they can affect multiple functions of the river landscape for different stakeholder groups. For example, (1) the visible structure in the river changes the view people have when looking across and along the river (Figure 1), (2) the erosion of banks and the disappearance of beaches and groynes affect how people have access to the river, (3) increased flow velocity may benefit or inhibit certain types of water recreation and (4) the creation of two separate channels for shipping (main channel) and recreational boating (secondary channel) affects navigation routes and safety. These changes can be viewed as both positive and negative, depending on factors such as personal aesthetic preferences or one's dependence on specific landscape elements (or the accessibility thereof) for doing certain activities. In this study, we assess the potential of the longitudinal dams to affect a number of different landscape values, including aesthetics, naturalness, biodiversity, flood safety, safety for navigation, accessibility and suitability for fishing.

2.2. People–place relationships

The complex relationship between people and nature includes commonalities and differences in how people perceive and give meaning to specific places (Yung *et al.*, 2003). As argued by Cheng *et al.* (2003), discussions and conflicts over natural resources, including rivers and their surrounding landscapes, are shaped by the meanings people attribute to these resources, both individually and informed by identification with relevant social groups. This perspective has stimulated a wide body of research into place attachment, which has, amongst others, been shown to play a role in perceptions of environmental conditions (e.g. recreation impact) (Kyle *et al.*, 2004) and change (Rogan *et al.*, 2005), as well as in people's willingness to be involved in participatory planning (Manzo & Perkins, 2006; Kil *et al.*, 2014). Studies have also indicated that levels of place attachment differ between groups such as proximate and distant water-based recreationists (Budruk *et al.*, 2011), visitors to different rivers (Warzecha & Lime, 2001), and native and non-native residents (Hernández *et al.*, 2007). From the perspective of the multifunctional river landscape, the importance of assessing place attachment among diverse stakeholders thus arises from two considerations. Firstly, groups may be categorized

in terms of differing levels of place attachment, and which dimensions of place attachment they consider most important. Secondly, these differences may aid scholars and practitioners to understand these groups' landscape perceptions and their views on the impacts of landscape changes. These considerations warrant the inclusion of place attachment in this study.

2.3. Trust

The inclusion of perceptions of different stakeholders also brings social relations and possible conflicts to the fore. One important dimension influencing stakeholders' perceptions of landscape interventions is trust. A lack of trust among the public can have major implications for water management, for example by people opposing or trying to steer policy decisions in a certain direction (Leahy & Anderson, 2008). Despite indications that officials of natural resource management agencies place great importance on public trust in the work of their organization (Green & Jones, 2018), empirical studies on trust between communities and agencies in natural resource management remain scarce (Smith *et al*., 2013). Insufficient communication and community engagement, limited community power and historical resentment can act as constraints to trust in collaborative management (Davenport *et al*., 2007). Measuring different aspects of trust is important to capture its complex nature. Leahy & Anderson (2008), for instance, highlight factors such as trust in the technical competence (e.g. in data and models) and shared interests between the community and government agency, which are incorporated in this study.

3. Methods

3.1. Selection of stakeholders

In our study, we surveyed four stakeholder groups: local residents, recreational anglers, recreational boaters and shipping professionals. Residents were included because their 'livelihoods are among the ones greatest affected by both floods and flood prevention measures' (Verbrugge & van den Born, 2018: p. 241), while the other groups were selected based on their recreational or professional use of the river (Ganzevoort & van den Born, 2019). For the residents of four nearby residential areas (Tiel, Wamel, Dreumel and Ophemert), postal questionnaires were distributed using addresses obtained from the GIS-department of Rijkswaterstaat. Our sample included all addresses in the villages of Dreumel (1,472), Ophemert (679) and Wamel (1,043). A systematic random sample of 2,000 addresses was drawn from the 16,754 addresses in the city of Tiel. The respondents received a hard copy of the survey but were also provided with a URL to complete the survey online instead.

For the recreationists, a link to the questionnaire was distributed via email, postal invitations, websites, social media and printed press of the national and a local angler's association, as well as websites and printed press of different watersport associations. The survey for shipping professionals was distributed via publications aimed at shipping professionals, and websites, social media and newsletters of their representative body. Following advice from their representative body concerning this group's time constraints and limited interest in participation in survey research, the questionnaire for this group was kept significantly shorter (see the next section 'Questionnaire'). All online questionnaires were available from October 2016 until January 2017.

3.2. Questionnaire

The results reported here focus on three central themes of the questionnaire: place attachment, trust and evaluation of the longitudinal dams (see Section 2). These questions were embedded in a larger survey about this river area. This study was also preceded by a baseline survey study among the same stakeholders (Verbrugge *et al.*, 2017).

Place attachment has been quantitatively studied using a wide variety of scales, based on a diversity of hypothesized dimensions. Raymond *et al.* (2010) drew on an earlier work to posit four dimensions of place attachment: place identity (emotional and symbolic ties to a place that help define who we are), place dependence (functional ties to a place for the services and opportunities it provides), social bonding (the role of a place in connecting us to other people) and nature bonding (a sense of connectedness to the natural environment in a place). As described in Ganzevoort & van den Born (2019: p 151), social bonding and nature bonding are distinguished 'because attachments to social and physical aspects of the environment appear to play different roles in shaping environmental concern […] and pro-environmental behaviour'. Narrative bonding (a sense of connectedness to the cultural and historical meaning of the landscape; see Verbrugge & van den Born, 2018) was only included in the survey for residents because they actually live in the area. In addition, for the sake of brevity, place attachment statements were not included for the shipping professionals.

The questionnaire included 4–5 statements per dimension of place attachment, e.g. 'I feel this river area is a part of me' for place identity or 'There are no better places for the activities I like to do than this river area' for place dependence (see Supplementary Material). This component of our survey consisted of 21 and 17 statements for residents and recreationists, respectively. The statements on place identity and nature bonding were identical, while several of the place dependence and social bonding statements were phrased differently to match residents or recreationists (Supplementary Material). To ensure comparability for the analysis, we adhered to the same number of statements for each group and made sure each group of statements reflected similar aspects of each dimension of place attachment. For instance, 'I live in this area because my family lives here' (for residents) and 'I would like to show this area to my (grand)children' (for recreationists) both reflect familial ties to the area. Respondents could indicate their level of agreement with each statement on a 5-point scale running from 'strongly disagree' to 'strongly agree'.

Trust in Rijkswaterstaat was measured with four statements: two about respondents' level of trust in the agency in relation to its main tasks: flood protection and waterway maintenance, one regarding trust in the data and models used by the agency (technical competence) and one asking whether the target group feels that the agency takes them seriously. Respondents could indicate their agreement with these statements on the same 5-point scale as above.

Views on the impact of the dams on the river area were measured for seven dimensions (naturalness, beauty, safety regarding flood risk, a better environment for flora and fauna, navigation safety, accessibility and suitability for fishing) and an overall assessment, with selection and wording of the dimensions differing slightly between the three surveys. Besides their assessment of the influence of the dams on these dimensions, we also asked the respondents to indicate how important these dimensions are to them.

Finally, some demographic background variables were asked; age, gender, level of education, number of years living in the area (for residents), number of years recreating in the area (for anglers and boaters)

and number of years working in the area and membership of a shipping association (for shipping professionals).

We used analyses of variance (ANOVA) in SPSS Statistics (version 21) to examine the mean differences in place attachment, trust and perceived influence scores among the stakeholder groups. For posthoc tests, Hochberg's GT2 was chosen to account for the large differences in sample size.

4. Results

4.1. Response

The response among the residents yielded 877 completed surveys; this represents a 17% response rate, which is similar to other large-scale perception studies among Dutch residents (Terpstra & Gutteling, 2008; Van Heel *et al.*, 2017) and was expected, considering only one reminder was sent. The sample contains slightly more males than females, an average age of 58 years and a fairly even distribution over different levels of education (Table 1). The majority of the respondents in this group (72%) has lived in the area for over 20 years, with an average of 40 years.

Compared to residents, the number of respondents was lower for the other groups: 158 recreationists (90 anglers and 55 recreational boaters) and 141 shipping professionals. This was expected because of the different sampling approaches (postal questionnaires vs. online surveys) and because recreationists and shipping professionals are more difficult to involve in survey research (Ganzevoort & van den Born, 2019). No response rates could be calculated for these groups. The majority of recreational anglers and boaters were male (96 and 86% respectively), while recreational boaters were generally older and more highly educated (62% were 60 years or older and 53% were highly educated) than the anglers (37% and 33%, respectively). On average, recreational anglers had been recreating in the area for a longer time

Table 1. Sample characteristics of the four stakeholder groups.[a]

	Residents ($n = 877$)	Recreational anglers ($n = 90$)	Recreational boaters ($n = 55$)	Shipping professionals ($n = 141$)
Gender (in percentages)				
Male	54.9	95.6	85.5	90.8
Female	39.6	2.2	9.1	4.3
Age (in percentages)				
Mean (SD)	58 (±14)	53 (±14)	63 (±9)	48 (±12)
Below 40 years	11.4	18.9	0	25.5
40–60 years	35.7	40.0	30.9	48.9
+ 60 years	45.7	36.7	61.8	18.4
Education (in percentages)				
Lower secondary education	27.1	28.9	18.2	25.5
Higher secondary education	34.9	34.4	23.6	56.0
College or university	34.6	33.3	52.7	6.4
Number of years residing/recreating/working				
Mean (SD)	40 (±23)	27 (±20)	18 (±14)	28 (±13)

[a]Percentages do not include 'no answer' and therefore do not always add up to a total of 100. The 'no answer' percentages range between 3.4 and 12.1.

than recreational boaters (27 and 18 years, respectively). The majority of the 141 shipping professionals were men (91%), and about half of this group were between 40 and 60 years old (49%). They reported to have been working on the Waal for between 6 and 64 years, with a mean of 28 years. All sample characteristics of the four stakeholder groups are summarized in Table 1.

4.2. Place attachment

Place attachment was included in the questionnaire for residents, anglers and recreational boaters. These three groups report average to high scores for each dimension of place attachment, with connection to nature receiving the highest scores (Table 2). Place identity comes in second for residents and recreational anglers, while recreational boaters score slightly higher on social bonding. Place dependence scores are relatively low, especially for recreational boaters. Some significant differences in mean scores between the groups can be noted. Residents and anglers feel more connected to nature in the area, and have a stronger place identity and place dependency than recreational boaters ($p < 0.001$). For social bonding, no significant differences were found.

4.3. Trust

Trust was measured using four items describing different aspects of trust in Rijkswaterstaat. The mean levels of trust for taking care of fairway maintenance and flood protection are average to high among all stakeholder groups (Table 3 and Figure 3). The scores for trust in being taken seriously by

Table 2. Average scores of residents, recreational anglers and recreational boaters for different place attachment dimensions (measured on a 5-point scale from 1 to 5), including significant differences.

	Residents	Recreational anglers	Recreational boaters	Sign. (ANOVA)
Place identity	3.80	3.82	3.09[a]	$p < 0.001$
Place dependence	3.40	3.29	2.68[a]	$p < 0.001$
Social bonding	3.34	3.44	3.11	n.s.
Connection to nature	4.01	4.04	3.40[a]	$p < 0.001$
Narrative bonding	3.23	n.a.	n.a.	n.a.

n.s.: not significant.
n.a.: not available.
[a]Mean score differs significantly from the other two groups ($p < 0.001$).

Table 3. Average scores and standard deviations of the four stakeholder groups for four items on trust in Rijkswaterstaat (measured on a 5-point scale from 1 to 5), including significant differences.

	Residents	Recreational anglers	Recreational boaters	Shipping professionals	Sign. (ANOVA)
Trust in flood protection	3.82 (0.77)[a,b]	3.67 (0.90)[a,c]	4.05 (0.80)[b]	3.43 (0.96)[c]	$p < 0.001$
Trust in fairway maintenance	3.77 (0.75)[a]	3.59 (0.95)[a]	3.95 (0.78)[a]	3.06 (0.97)[b]	$p < 0.001$
Trust in data and models	3.54 (0.81)[a]	3.40 (0.92)[a]	3.71 (0.85)[a]	2.81 (0.89)[b]	$p < 0.001$
Feels taken seriously	3.44 (0.91)[a]	3.01 (1.18)[b]	3.38 (0.89)[a,b]	2.62 (1.11)[c]	$p < 0.001$

Different superscripts indicate significant differences at the $p = 0.05$ level.

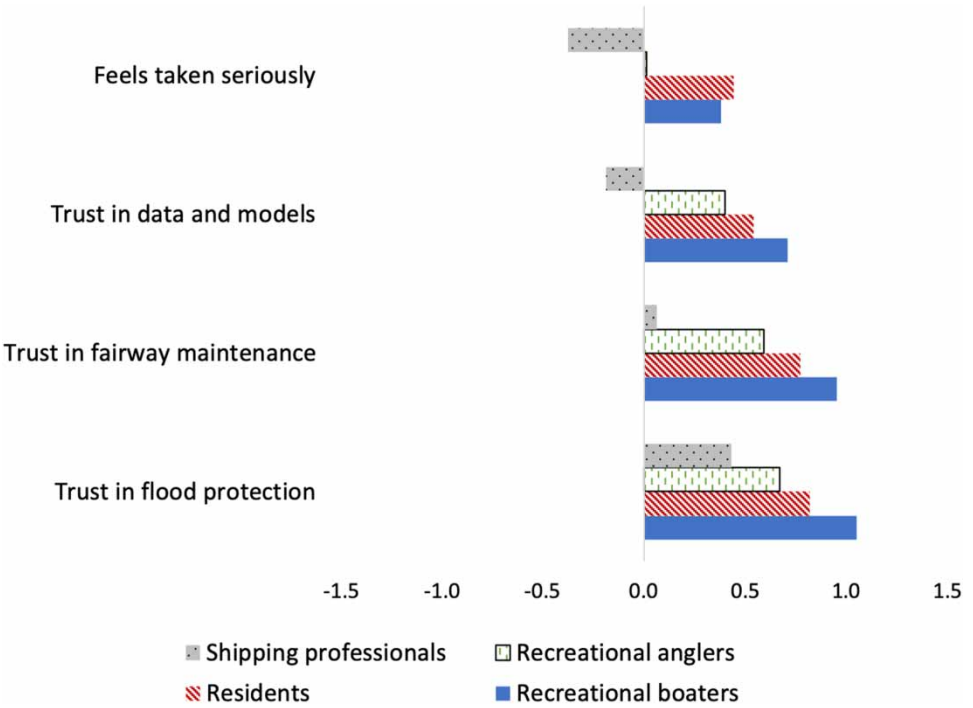

Fig. 3. Responses of stakeholder groups to four statements about trust in Rijkswaterstaat (measured on a 5-point scale). For visual clarity, the scale was recoded to a scale running from −2 to 2. Significant differences between groups can be found in Table 3.

Rijkswaterstaat show more diverse responses ranging from slightly negative (shipping professionals) to neutral (recreational anglers) and slightly positive (residents and boaters). Trust in the data and models shows almost the same pattern except for anglers being more positive in this case. When focussing on the differences between the four stakeholder groups, residents and recreational boaters report the highest scores on all four trust aspects, with boaters having more trust in flood protection and fairway maintenance. Shipping professionals score significantly lower than the other three stakeholder groups on all four aspects of trust. Anglers report slightly lower trust than boaters with regard to flood protection and feel taken somewhat less seriously than residents.

4.4. Longitudinal dams

Overall, the stakeholder groups considered the effects of the dams on the naturalness and the beauty of the river landscape as slightly negative (Figure 4). With the exception of the shipping professionals, the stakeholders assess the river landscape with longitudinal dams as safer regarding flood risk and for navigation. Recreational boaters and residents were most similar in their reaction; they were negative about the naturalness and beauty of the landscape after the construction of the dams and positive about the effects on flood risk and navigation safety. The anglers perceive the river landscape as having become less accessible, beautiful, natural and suitable for fishing due to the construction of the dams, but are moderately positive about safety regarding flood risk and navigation and about the

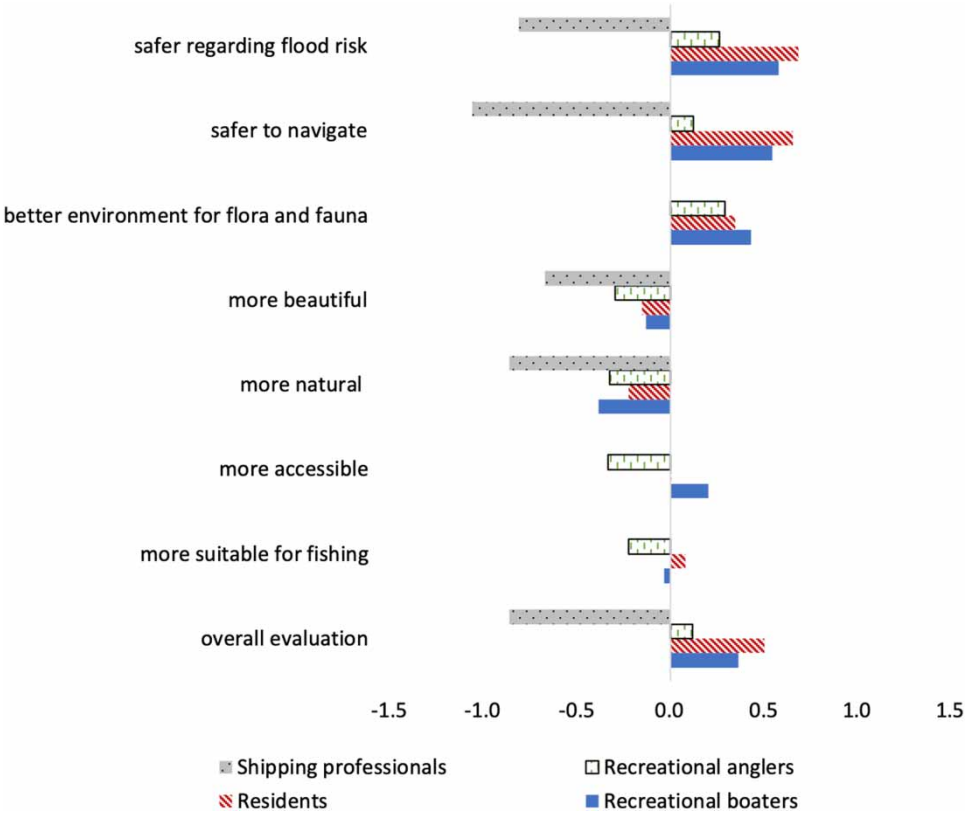

Fig. 4. Responses of four stakeholder groups to the statements: 'In my opinion the placement of longitudinal dams make the landscape…' For visual clarity, the scale was recoded to a 5-point scale running from −2 to 2. Significant differences between groups can be found in Table 4.

effects on flora and fauna. Shipping professionals score significantly lower than the other groups on all four dimensions that were included in their survey (naturalness, beauty, flood risk safety and navigation safety). Moreover, this stakeholder group was asked whether they regarded the river easier to navigate after the construction of the dams, which was also assessed negatively with a score of 2.08 on a scale from 1 to 5. Shipping professionals are also the only stakeholder group to assess the dams negatively when it comes to overall evaluation (Table 4).

Next, we compared the scores expressing the importance given to each aspect between the members of the four groups. Overall, we found that the two safety aspects (flood safety and safety for navigation) were considered highly important by all groups. Residents assigned the highest importance score to flood safety (4.24) which they considered more important than recreational anglers (3.93), recreational boaters (3.87) and shipping professionals (3.72) ($p < 0.001$). In line with their interests, recreational anglers considered the suitability for fishing (4.17) and creating a better environment for flora and fauna (4.03) as most important. Residents and recreational boaters scored lower on these two aspects, although improved conditions for flora and fauna still came in third place for both groups. Both beauty and naturalness received moderate scores from all groups but were more important to residents (3.62 and 3.80 for beauty and naturalness, respectively) and recreational anglers (3.39 and 3.70)

Table 4. Average scores and standard deviations of the four stakeholder groups regarding their perceptions on the impact of the longitudinal dams on the river area for seven dimensions and an overall assessment (measured on a 5-point scale from 1 to 5), including significant differences.

	Residents	Recreational anglers	Recreational boaters	Shipping professionals	Sign. (ANOVA)
Safer regarding flood risk	3.69 (0.96)^{a}	3.26 (1.06)^{b}	3.58 (1.01)^{a,b}	2.19 (1.05)^{c}	$p < 0.001$
Safer to navigate	3.66 (0.92)^{a}	3.13 (1.08)^{b}	3.55 (1.32)^{a,b}	1.94 (0.92)^{c}	$p < 0.001$
A better environment for flora and fauna	3.35 (0.96)^{a}	3.29 (1.26)^{a}	3.43 (1.06)^{a}	n.a.	n.s.
More beautiful	2.85 (1.07)^{a}	2.70 (1,17)^{a,b}	2.87 (1.07)^{a}	2.33 (1.01)^{b}	$p < 0.001$
More natural	2.78 (1.07)^{a}	2.67 (1.13)^{a}	2.62 (1.10)^{a}	2.14 (1.02)^{b}	$p < 0.001$
More accessible	3.01 (1.09)^{a}	2.67 (1.19)^{b}	3.20 (1.12)^{a}	n.a.	$p < 0.01$
More suitable for fishing	3.08 (0.94)^{a}	2.78 (1.48)^{a}	2.97 (1.00)^{a}	n.a.	n.s.
Overall evaluation	3.50 (1.09)^{a}	3.12 (1.23)^{b}	3.36 (1.25)^{a,b}	2.14 (1.03)^{c}	$p < 0.001$

Different superscripts indicate significant differences at the $p = 0.05$ level. n.s. = not significant, n.a. = not available.

when compared to recreational boaters (3.05 and 3.27) and shipping professionals (2.29 and 2.60) ($p < 0.001$). No differences between groups were found for the assigned importance to accessibility, which also received moderate scores (between 3.40 and 3.58).

5. Discussion

In this study, we surveyed four different stakeholder groups for their perceptions on the impacts of newly constructed longitudinal dams on different landscape values and functionalities of the river. Our results reflect the often-heard call for a tailor-made approach (e.g. Demetropoulou *et al.*, 2010; Ganzevoort & van den Born, 2019), for example, in the involvement of and communication with stakeholders, as the four groups clearly differ in their perceptions of and attachment to the river landscape. In this section, we firstly tie together the different results per stakeholder group and secondly make a comparison with findings from the baseline study.

The residents have a high level of place identity and nature bonding, meaning that living in this place is important for who they are and that they feel particularly connected with nature in the area. Their negative perceptions of the effects of the dams on the naturalness and beauty of the landscape are likely linked to these high levels of place attachment; the current natural landscape is important to them and they feel attached to it, so they do not appreciate the technological intervention in the landscape. Although their aesthetic valuation is thus negative, they do believe the dams improve flood risk safety in the area and they trust Rijkswaterstaat on all four dimensions (flood protection, fairway maintenance, data and models and taking stakeholders seriously), reflecting a positive evaluation of the functionality of the dams and the knowledge and skills of Dutch water managers.

The anglers, who are dependent on the area to fulfil their recreational needs, indeed show a higher level of place dependence than the recreational boaters, and their high place identity and connection to nature are comparable with the residents. Their negative valuation of the accessibility of the area and the suitability of the area for fishing is a clear indication that they feel the dams are threatening the possibilities to perform their leisure activities. Moreover, they assess the landscape as less natural and less beautiful after the construction of the dams. Concerning trust, Rijkswaterstaat seems to receive

the benefit of the doubt of the anglers, as they are moderately positive on most aspects of trust we measured. However, regarding the feeling of 'being taken seriously', Rijkswaterstaat still has to gain the confidence of the anglers. This probably has to do with previous river projects in which anglers participated but felt that their opinions were not really taken into account (Verbrugge *et al.*, 2017), as negative experiences in past projects can explain lower levels of trust within specific stakeholder groups (Davenport *et al.*, 2007).

The recreational boaters are less dependent on the area than the residents and the anglers, which is reflected in their lower levels of place identity and place dependence. Although the difference is small and not statistically significant, boaters also report the lowest level of social bonding of all stakeholder groups. Similar to the other stakeholders, the boaters think that the area is less natural and less beautiful after the construction of the dams, but they are positive about the effects on navigation safety and flood safety. Boaters are also moderately positive about the feeling of being taken seriously by Rijkswaterstaat and about the models and data Rijkswaterstaat uses. One might expect levels of trust to be lower, considering the fact that, contrary to initial plans, there have been few opportunities so far for recreational boaters to actually travel through the secondary channel due to sediment build-up. Our results, however, indicate a relatively stable level of trust in Rijkswaterstaat.

Rijkswaterstaat has significantly invested in their relationship with shipping professionals, for example, through long-term collaboration with the national shipping association. However, despite these efforts, this stakeholder group has the most negative perceptions on all four effects of the dams that they scored (naturalness, beauty, flood risk safety and navigation safety) and are the only stakeholder group that reported a negative overall evaluation of the dams and reported the lowest levels of trust in Rijkswaterstaat across all four dimensions. We found no significant differences in the answers to these questions of those shippers who are the members of the shipping association ($n = 83$) and those who are not ($n = 59$), indicating that this is not a reflection of the views of a specific sector association. Particularly noteworthy here is their low confidence in fairway maintenance, which is crucial for this group as it greatly affects their ability to do their job. In addition, the shipping professionals reported that they experienced the fairway as having become smaller due to the dams, and that they have less possibilities to overtake other ships compared to the previous layout with the traditional groynes.

If we compare these results with the baseline study performed in 2014 (Verbrugge *et al.*, 2017), we see a similar picture: before construction residents and recreational boaters were more positive about the longitudinal dams. The residents' and anglers' perceptions are slightly more positive in 2016, although the anglers' perceptions on the accessibility and suitability of the area for fishing are still negative. The highly negative scores of shipping professionals regarding the effects on naturalness, beauty, flood risk safety and navigation safety are even more notable when compared to the baseline study, where this group had a much more neutral attitude towards the dams.

In addition, for both residents and recreationists, the attachment to the area has changed compared to the data from 2014. While for residents, the area has become less important for their personal identity, for recreationists, natural and social bonds have weakened. Anglers also appear to feel less dependent on the area (possibly because they have moved to other fishing spots); residents from the villages Wamel and Dreumel, on the contrary, feel more dependent. We expect the higher place dependency of villagers (compared to city dwellers) to be a result of a stronger bond with the unique river landscape via cultural history. The results regarding place attachment are in accordance with previous research showing that a changing landscape often goes hand in hand with lower feelings of connectedness (Buijs, 2009).

However, previous studies have also shown that attachment to the landscape can be rebuilt by means of new experiences (Åberg & Tapsell, 2013).

6. Conclusions and recommendations

Our case study has shown how perception studies can elicit important information on how stakeholders perceive landscape change. Not only did stakeholder groups differ in which functions of the river landscape they found most important but also in how they perceived the longitudinal dams to influence the landscape. In addition, the four stakeholder groups demonstrated different levels of place attachment, and these patterns were different for distinct dimensions of place attachment. Finally, stakeholders differed in their reported levels of trust in the executive agency. These insights can serve as an important starting point for adaptive management, by allowing water managers to make an inventory of the landscape functions most strongly valued by different stakeholder groups and those perceived as most threatened by landscape interventions. In addition, different forms and levels of attachment between stakeholders and the landscape can help to understand different perceptions of landscape interventions and are thus relevant to include. In the adaptive management process, managers can then adjust their communication strategies, their compensation measures, their monitoring programmes or even the intervention itself to signals from those stakeholders connected with and dependent on the river landscape.

Despite the relevance and importance of perception studies and adaptive management approaches, as outlined above, water managers often struggle to initiate and incorporate such approaches. Water managers are forced to balance an interest in incorporating stakeholder perceptions with their limited room for manoeuvre as a result of project aims and legal requirements. This conflict was also witnessed in the WaalSamen collaborative monitoring group, where Rijkswaterstaat had to balance their role as both facilitators of the multi-stakeholder monitoring platform, and their legal restraints due to being responsible and accountable for the design, construction and maintenance of river interventions. Moreover, they face cultural restraints, both regarding (limited) views on participation within Rijkswaterstaat (van den Brink, 2009) and the dominant Dutch societal discourse on the government being responsible for flood protection (Kaufmann, 2018). As noted in the introduction, current science-policy interfaces leave little room for including stakeholder perceptions (Bergsma, 2016), diminishing the potential for adaptive management.

However, we strongly urge water managers to face these challenges and stimulate the inclusion of adaptive approaches in the design, implementation and management of their river interventions. Our case study presents an approach for stakeholder involvement in monitoring and the evaluation of river interventions. While in our case study stakeholders were not involved in the design phase, there are also different tools and approaches available for including stakeholders in planning and design. Depending on the context, water managers can use serious gaming (Carson *et al.*, 2018), perspective-based simulation games (Valkering *et al.*, 2012) or participatory modelling (Basco-Carrera *et al.*, 2017). Some studies have reviewed the potential (Carson *et al.*, 2018) or actual (Den Haan & van der Voort, 2018) effects of serious gaming and similar approaches on learning and perceptions, although Carson *et al.* (2018) note that further empirical evaluations would be necessary.

The experiment with the longitudinal dams has provided an opportunity to monitor a wide variety of relevant parameters within the monitoring platform, including stakeholder perceptions on the

naturalness, beauty and safety of the landscape. In addition, it also enables decision-making on success or further application of these interventions to move beyond a simplified 'yes or no' based on narrow criteria (e.g. only hydrological parameters or cost saving) and instead to consider a much more comprehensive set of dimensions that more accurately reflect the multifunctional nature of the river landscape. Moreover, it creates opportunities for stakeholder representatives to experiment with more extensive cooperation and new roles within a collaborative project (Fliervoet & van den Born, 2017). The opportunity to collect a large dataset of stakeholder perceptions, as presented in this paper, affords the pilot project the chance to respond to stakeholder concerns to a greater degree. We argue that these benefits far outweigh the difficulties and invite river managers the world over to attempt the same.

Conflict of interest

This study was conducted as a part of the research programme RiverCare and was financed by NWO-TTW and the Ministry of Economic Affairs under grant number P12-14. Rijkswaterstaat was a co-funder of this project but was not involved in the design, data collection, analysis or reporting of this study.

Acknowledgements

We thank Bernadette van Heel for supporting the data entry, the Royal Dutch Yachting Association, the shipping association 'Koninklijke BLN Schuttevaer' and the angler associations 'Hengelsport Federatie Midden-Nederland' and Royal Dutch Angling Association for their help in distributing the survey.

Supplementary material

The Supplementary Material for this paper is available online at https://dx.doi.org/10.2166/wp.2019.073.

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Received 17 April 2019; accepted in revised form 5 November 2019. Available online 28 November 2019